

Medicinal and Aromatic plants (MAPs) Conservation Programme in Europe

Prof.dr. Baričevič Dea

University of Ljubljana, Biotechnical Faculty, Agronomy Department, Jamnikarjeva 101,
1000 Ljubljana, SLOVENIA

MAPs used as a food and medicine since the beginning of mankind



- Through observation of the benefits of natural ingredients: agents for preserving foods, alternating the taste of foods and for health curing preparations – majority of plants grew as a natural component of vegetation of certain area.



- Domestication of wild species used as food and condiments and introduction into cultivation – key anthropogenic contribution in assurance of sufficient quantity of food in urban environments



- ▶ Early part of the 20th century: the interest and belief in the benefits of herbs and spices decreased with developments of "natural and biological sciences" and the introduction of synthetic products
- Last decades of 20th century, beginning of the 21st century: traditional plant based preparations back in use and find increasing applications as source of herbal remedies, food supplements, flavourings, natural cosmetics, essential oils and feeds.

Uses in food, phytotherapy, processing industries –
↑ demand: over-exploitation, pressure on natural habitats

- The global market for herbal products that include medicines, food supplements/functional food products and herbal cosmetics, was estimated at around US \$ 62 billion in 2007. Out of this, the market for herbal remedies alone was estimated at US \$ 26.2 billion (<http://sanjivaniherbals.com/herbal-information.html>).
- Wild plants: used as raw materials for the elaboration of more complex semi-synthetic chemical compounds, as models for new synthetic compounds or as taxonomic markers for the discovery of new compounds.
- The production, consumption and international trade in MAPs and phytomedicines, therefore, are growing and are expected to grow in future significantly.



Resource under pressure

30 - 45% of medicinal plant species may be threatened with extinction in the wild.

WWF : 4,000 and 10,000 plants may be at risk

- 4/5 world population depends on natural medicines
- More than 90 % of MAPs gathered from the wild
(Europe: 30.000 tons/year: Turkey; Albania, Spain...)
- **Medicinal Plants Used** (Timoshyna, 2009):
about **17,000** species well-documented, **50,000** plant species used globally
- **Traded:** about **3,000** species internationally
- **Commercially Cultivated:** only about **900** species world-wide



Conservation measures for MAPs and of other socio-economically important plant species needed



- Last 2 decades of the 20th century: MAP scientific and professional fora were aware and stressed the need on conservation of wild plants already in trade or those with potential socio-economic value
- Sources of MAPs are becoming increasingly scarce due to over-collection and factors affecting natural MAP populations/habitats:
- Habitat destruction, global warming, grazing: knowledge on available wild genetic resources is rather scarce in majority of EU countries; *The effects of climate change and habitat destruction and their interaction are likely to be the greatest challenge to animal and plant conservation in the twenty-first century.; Global warming could wipe out a quarter of all species of plants and animals by 2050 in one of the biggest mass extinctions since the dinosaurs, according to an international study (<http://www.urbanecology.org.au/topics/biodiversitythreats.html>); Biodiversity on Earth is product of more than four billion years of evolution and we could destroy it in much less time, since current estimations show that more than 25000 species are driven to extinction every year (<http://ecologicalproblems.blogspot.com/2008/05/biodiversity-loss-is-not-only.html>)*
- Existing legislation at national and European levels not adequate – limited number of species officially protected, important MAP species endangered. These species should be identified, conserved (*in situ* or *ex situ*) and proposed for official protection; for areas largely reliant on oral rather than written tradition, loss of MAPs natural resources means not only an immediate loss of effective remedies/food but also a rapid erosion on knowledge of their use.

Conservation measures for MAPs and of other socio-economically important plant species needed



- **Before 1993 no professional directives** on sustainable collection, regeneration and cultivation of MAPs in many countries: over-exploitation from a wild led to the habitat loss and extinction or endangerment of MAP species
- **Guidelines on The Conservation of Medicinal Plants (1993, WHO, IUCN, WWF); WHO Guidelines on good agricultural and collection practices (GACP) for medicinal plants (WHO, 2003);** where the significance of ecology, identification and traditional use of plants, as well as cultivation and conservation of plants both *in situ* and *ex situ* are strongly emphasized.
- Guidelines offer the background supporting documents for many national and international initiatives, programs and frameworks, aimed at improving the knowledge on ***distribution, abundance, sustainable management and use*** of medicinal plants worldwide.

Conservation measures for MAPs and their natural habitats

- To stop further biodiversity loss – **methods and measures** needed for:
- Monitoring and evaluation remaining stocks of MAP populations *in situ*
- Evaluation MAPs natural habitats
- Conservation, management of selected populations in the direction of maintenance of the natural evolutionary processes, thus allowing new variation to be generated in the gene pool that will allow the species to adapt to changing environmental conditions such as global warming, changed rainfall patterns, elevated CO₂ conc., habitat loss.
- Maintenance and sustainable management of natural habitats - ecosystems and biological resources is possible only after the basic decision change **wild-gathering** ➔ **agricultural production** of any raw materials that has been subjected to the growing commercial demand



MAPs natural resources and habitats conservation measures will ensure the continued availability and use of MAPs



- Aims:
 - ▶ Conservation of natural heritage
 - ▶ Sustainable management MAPs natural resources
 - ▶ Improvement of the knowledge on the MAPs genetic variability and implementation of breeding programs

- Measures should involve different approaches:
 - ▶ Prohibition of the trade of wild MAPs
 - ▶ Prevention of the destruction of plant natural habitats through monitoring and control the factors affecting plant species
 - ▶ Documentation the abundance of natural MAPs populations
 - ▶ Promotion conservational needs
 - ▶ Domestication of wild plants and their cultivation in order to achieve continuity of product quality and maintenance of active ingredient standardization.

Establishment of **ECP/GR MAP WG** (October 2001): effective collaboration in the field of conservation, sustainable management and use of MAP GR



1st meeting: September 2002, Gozd Martuljek, Slovenia (32 participants),
2nd meeting: December 2004, Strumica, FYR Macedonia (34 participants),
3rd meeting: June 2007, Olomouc, Czech Republic (26 participants).



Members expected to:

- contribute to the development of the conservation strategy of MAPs at the European level in partnership with a variety of actors (at local, national and international levels);
- deploy a variety of tools that contribute more effectively towards the common scope – conservation of MAPs and their habitats in the European region - professional measures/ criteria/ protocols/ descriptors for inventarization and survey of endangered MAP populations, their *ex situ* maintenance, regeneration, characterization and evaluation;
- identify biodiversity drop: monitoring the impacts with bad influence on the status of the endangered species (natural succesion – reforestation; direct extermination - collecting, meliorations, agricultural activities, infrastructure);

Role of ECP/GR MAP WG in conservation and sustainable use of MAPs



Members expected to:

- establish protocols for eco-geographical surveying of target species;
- implement actions for control or removal of factors that cause the threats, management or recovery should be implemented through natural resource managers, local communities and policy makers;
- elaborate protocols for collecting of seed material of rare, vulnerable plant species and transfer to *ex situ* collections;
- promote domestication of wild species that indicate an increasing trend in economic importance.

ECP/GR MAP WG

Short-term tasks



▶ **Selection of a list of priority species/genera**

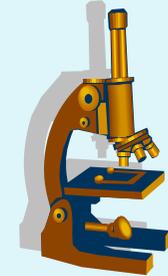
- The Group concentrated its short-term activities on a small number of species/genera of importance to all members and considered as needing urgent attention.
- The methodology developed for these priority species/genera would serve as a model for other species

Achillea millefolium agg., *Artemisia absinthium*, *Carum carvi*, *Gentiana lutea*, *Hypericum perforatum*, *Melissa officinalis*, *Mentha* spp., *Origanum vulgare*, *Salvia officinalis*, *Thymus* ssp.

▶ **Inventory of MAP populations at national and/or international levels**



ECP/GR MAP WG Long-term tasks



- ▶ Harmonization and unification of methodologies used during surveys and experimental field work, characterization/evaluation of MAPs, accession management recommendations and promotion of the introduction of MAPs into cultivation
- ▶ Development of agrosystems and cultivation of MAPs should be considered as the only way of protection of MAPs natural resources and their sustainable use in conditions of an increased market demand for raw materials. Sustainable use of MAPs in Europe can be achieved only by further introduction of "wild" plants into cultivation



Conservation programme for MAPs that are not individually protected or a part of protected areas in Europe Summary



- Inventory, survey and mapping of MAP ⇒ harmonization
- Characterization of natural resources/through collecting of wild accessions ⇒ harmonization
- Conservation *in situ* and *ex situ* ⇒ harmonization
- Evaluation and documentation ⇒ harmonization
- Cultivation in commercial plantations/agrosystems (GAP)

Cultivation: the only way to assure the product with attributes such as safety, quality and efficacy, retain utilization of herbal product and support acceptance on the market

ECP/GR MAP WG

Descriptor lists



Survey, Mapping, Characterization

Harmonization possible when descriptors defined

- **1. Passport** (accession descriptors + collecting descriptors) general designation of the accession and its origin background information (passport descriptors) including description of parameters that should be observed when the accession is originally collected
- **2. Management** (management descriptors + multiplication/regeneration descriptors): technological instructions needed for the management of accessions within a genebank for their regeneration and multiplication (multiplication, harvest, drying, seed storage,...)
- **3. Environment and Site** : describe environmental and site-specific parameters that are important when characterization and evaluation trials (either *in situ* or *ex situ*) are held
- **4. MAP characterization/Evaluation** (morphological, chemical and cytological descriptors, abiotic or biotic stress susceptibility, molecular markers). Characterization will normally be the responsibility of genebank curators

Harmonization of methodologies based on the principles of a descriptor system

Collecting descriptors

- ▶ Collecting descriptors describe all parameters which have been obtained **during inventarization and/or survey** (mapping) of genetic resources and provide basic information for managing of accession, including **registration, identification**, ethnobotanical and ethnographic (folkloristic characteristics) data. Collecting descriptors comprise all **data registered at field working**, and which **describe natural habitats together with natural genetic resources**.

Harmonization of methodologies based on the principles of a descriptor system

Environment and Site descriptors

- ▶ Environment and Site descriptors **explain environmental** (geographic, soil-pertaining, topographic, phytocoenological, micro-climatic) and **habitat-specific parameters**, which are **important for characterization**, estimation of **abundance** or eventual endangerment as well as for **assessment of useful properties** of a particular genetic source which can be attributed to interaction between ecotype and environment.

Harmonization of methodologies based on the principles of a descriptor system

Characterization descriptors

- ▶ Characterization descriptors express **morphological, taxonomic, cytological, chemical, production** (biomass/ m²) and **usage characteristics** of respective specimens (20 – 25 entities per population) of natural genetic resources and are crop-specific.
- ▶ Examples for characterization descriptors of the following model species have been provided :
Achillea millefolium agg., *Carum carvi*, *Gentiana lutea*, *Hypericum perforatum*, *Mellisa officinalis*, *Mentha* spp. (*M. piperita* and *M. Spicata*), *Origanum vulgare*, *Thymus* spp. (*T.vulgaris* and *T. Serpyllum*).

Harmonization of methodologies based on the principles of a descriptor system

Evaluation descriptors

- ▶ Evaluation descriptors will be used in **ex situ evaluation** of genetic resources of a specimen under the study (20 – 25 entities per population) and consist of observations/measurements of **plant biomass** (fresh and dry in g/plant), of **regeneration potential** (weight of 1000 seeds, possibility for vegetative propagation), of **earliness** (measured by description of **developmental stages**: initiation of flowering, period from initiation of flowering to the full flowering stage), of determinations of the contents of the usage-defined secondary metabolites and of evaluation of sensitivity of a genetic source for abiotic and biotic stress factors, with a characterization of a stress factor.

India: Policy makers and professionals succeeded to synergize values of ethnobotanical and ecological knowledge for conservation of useful species

➤ **Ethnobotanical model** (north)

Examples of ethnobotanical model of conserving MAPs include the philosophy of sacred groves, sacred species and sacred landscape.



➤ **Medicinal and aromatic plants conservation areas (MAPCA) (south)**
– **Community Based Conservation Model**

Ensures the autonomous development of a rural community by enhancing the people's income - they can decide themselves: how to use their resources, for which market they wish to produce, by which services they need to achieve their goals.

Enables community: to restore resources depleted by overuse, to assume the long term supply of resources, regulate national and international trade by assuring a continuous supply of quality material.

India: Importance of indigenous knowledge for conservation of biodiversity



➤ Area under conservation – **MAP conservation areas**)

In-situ..... 20,000 ha

Ex-situ/ Herbal gardens, gene banks..... 4,000 ha

➤ MAP cultivation area.....142, 000 ha

Large scale farming of useful and threatened MAPs has been recommended by Government of India as possible solution for conservation of the species in the wild.

Result: more than 80 species of MAPs selected and brought under cultivation.

MAPs are domesticated purely on the traditional knowledge systems.

International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants (ISSC-MAP)

Version 1.0

Medicinal Plant Specialist Group
Species Survival Commission
IUCN The World Conservation Union



BfN-Skripten 195

2007

Sustainable wild collection and conservation requirements

Legal and ethical requirements

Management and business practices

International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants
DECISION BOARD



MEDICINAL
PLANT
SPECIALIST
GROUP



Traditional Medicinals

ISSC-MAP implementation has been initiated in selected projects

- ▶ **Bosnia-Herzegovina**

Implementation of the ISSC-MAP in co-operation with partners from the local private sector and government authorities

- ▶ **Nepal**

Use of ISSC-MAP in conservation areas and buffer zones managed by local communities

- ▶ **Brazil**

Model implementation at community level in Acre, Amazon

- ▶ **India**

Karnataka: ISSC-MAP Implementation along the mandi trade chain

- ▶ **China**

Inclusion of ISSC-MAP into the development of regional resource management

- ▶ **Lesotho**

Development of a regional management plan (*Pelargonium sidoides*) together with national authorities

- ▶ **Cambodia**

Identification of priority species and development of a local model implementation project

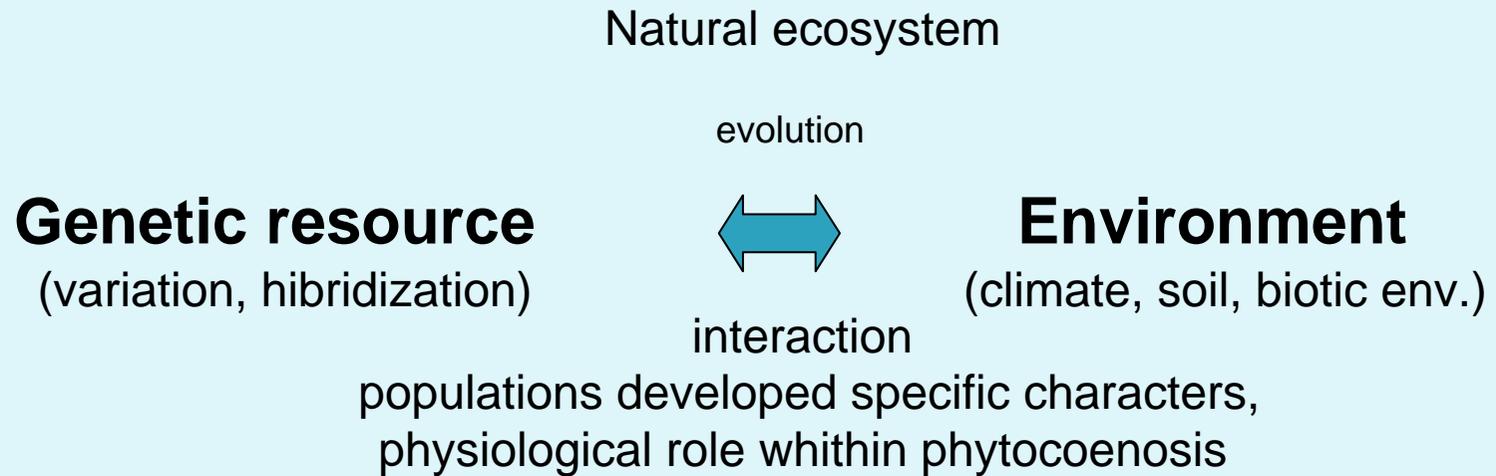
⇒ MAP cultivation and
the quality of raw materials



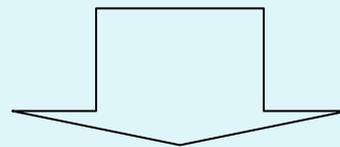
Collection from the wild		Cultivation	
advantage	deficiency	advantage	deficiency
low cost	variable quality	selection/breeding- ↑↑ quality adjustment	high cost
	unsteady supply (time, quantity)	planned supply (time, quantity)	
	contamination (lead, cadmium, radionuclids...)	choise of uncontaminated production localities	
	inspection and quality control of various sources infeasible	possible inspection/declaration of quality	
	possible mistaking, falsification	cultivars/accessions taxonomically defined	
	natural resources loss	natural resources conservation	



Genotype (genetic resource) and environment interaction



Knowledge of natural ecological conditions, known genetic source



Cultivation technology

Agrosystem

Plant genetic resources (PGR) of MAPs and other socio-economically important species

- Define the genetic diversity of the species.
- Historically, plant genetic resources (PGR) conservation has focused almost explicitly on cultivated plants.
- Recently, crop wild relatives (CWR) and wild-harvested species have been acknowledged as being equally important from conservational aspects.
- Essential biological source material for food supply assurance in the period of increasing rate of population in 21st century, for development of breeding programs (resistance, quality, yield), for development of agriculture, pharmaceutical and other processing industries and thus an actual or potential economic benefit for humankind at national, regional and global levels.
- Successful supervision over the actual and future use and conservation of natural resources/ecosystems could be done through all aspects of PGR (monitoring, evaluation, conservation, documentation).

Conservation of MAP diversity in Europe



- ▶ Conservation of biodiversity and sustainable use of MAPs represent the basis for variety development and quality control of raw materials used in target processing industries (pharmaceutical, food, cosmetic...) and thus new economic opportunities for the country (Schneider E. 2006: *Supplier audit in MAP collection and cultivation: Buyerperspective in Germany.- Medicinal Plant Conservation, Vol.12, 12-17*)

4th ISBMAP Symposium



- ▶ Cultivars of basil resistant against downy mildew (*Peronospora* sp.) and tolerant to low temperatures
- ▶ Development and characterization of parsley (*Petroselinum crispum*) lines resistant to the pathogen causing leaf blight (*Septoria petroselinii*)
- ▶ Selection and inbreeding of *Origanum majorana* for maximising the essential oil content
- ▶ Combination of small fruits and high essential oil content by crossing of bitter fennel (*Foeniculum vulgare* Mill. ssp. *vulgare* var. *vulgare*)
- ▶ Breeding varieties of Thyme (*Thymus vulgaris*) with high performance and homogeneity with regards to yield, quality, winter hardiness, flowering period
- ▶ *Hypericum perforatum* for the selection of wilt resistant (caused by *Colletotrichum* cf. *gloesporioides*) strains
- ▶ Breeding the annual form of caraway (*Carum carvi* L. var. *annuum* hort) for improved yield and essential oil
- ▶ Studies on the inheritance of poppy (*Papaver somniferum* L.) alkaloids and the new cultivar 'Korona' accumulating high concentrations of narcotine .





Thanks for your kind attention!